

CLAIMS

1. A method of producing an aircraft assembly tool for supporting an aircraft component comprising:
 - 5 a) determining a plurality of predetermined positions and orientations in space at which the component should be supported;
 - b) designing a fixture frame configured to provide support at predetermined locations of the frame associated with said predetermined positions;
 - 10 c) constructing the fixture frame by selecting elongate members having predetermined lengths and connecting the elongate members together by means of releasable fastening means;
 - d) constructing a plurality of pick-up devices, each having a receiving element for carrying the component, by selecting further elongate members
15 having predetermined lengths and connecting the further elongate members together by means of clamping elements adapted selectively to allow at least three degrees of freedom of movement of each receiving element along at least two orthogonal axes and around at least one axis coplanar with the orthogonal axes;
 - 20 e) mounting the pick-up devices to the fixture frame at the predetermined locations; and
 - f) moving each receiving element along/around the orthogonal axes to align the receiving element with a respective predetermined position and orientation.
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2. A method according to Claim 1 in which the step f) comprises setting a respective receiving element approximately in its predetermined position and orientation, and iterating the steps of measuring the actual position and orientation of the respective receiving element and moving it towards the
30 predetermined position and orientation until it achieves the predetermined position and orientation.

3. A method according to Claim 1 or Claim 2 in which the clamping elements are adapted selectively to allow six degrees of freedom of movement, along and around three orthogonal axes, step f) comprising moving each receiving element along and around three orthogonal axes.
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4. A method according to Claim 1, 2 or 3 in which the predetermined positions and orientations are determined from computer aided design data for an associated component.
- 10 5. A method according to Claim 2, or Claims 3 and 4 when dependent on Claim 2, in which the actual position and orientation of each receiving element are measured and compared to the predetermined position and orientation as determined from computer aided design data for an associated component.
- 15 6. A method according to any of Claims 1 to 5 in which the actual position and orientation of each receiving element is measured by means of a laser tracking device.
- 20 7. An aircraft assembly tool for supporting an aircraft component comprising:
- a) a fixture frame configured to provide support at predetermined locations of the frame associated with a plurality of predetermined positions and orientations in space at which the component is to be supported;
- b) the fixture frame comprising elongate members having predetermined lengths connected together by means of releasable fastening means;
- 25 c) a plurality of pick-up devices, each having a receiving element for carrying the component and comprising further elongate members having predetermined lengths connected together by means of clamping elements adapted selectively to allow at least three degrees of freedom of movement of each receiving element along at least two orthogonal axes and around at least
- 30 one axis coplanar with the orthogonal axes;
- d) the pick-up devices being mounted to the fixture frame at the predetermined locations; and

e) each receiving element being aligned along/around the orthogonal axes with a respective predetermined position and orientation.

- 5 8. An assembly tool according to Claim 7 in which the clamping elements are adapted selectively to allow six degrees of freedom of movement, along and around three orthogonal axes.
- 10 9. An assembly tool according to claim 7 or 8 in which a modular construction is employed for the fixture frame, the elongate members each comprising an extruded section, and the fastening means each comprising a threaded connecting element provided by, or receivable within, one elongate member, and threaded receiving means provided by, or receivable within, another elongate member and engageable by the connecting element.
- 15 10. An assembly tool according to claim 7, 8 or 9 in which a modular construction is employed for the pick-up devices, the elongate members of the pick-up devices comprising cylindrical members releasably connected together by the clamping elements so as to permit relative rotation of the cylindrical members about and/or displacement along three orthogonal axes.
- 20 11. An assembly tool according to claim 7, 8, 9 or 10 in which the said elongate members of the fixture frame are rectangular in cross-section or have each at least one substantially flat or planar surface for clamping a said pick-up device thereto.
- 25 12. An assembly tool according to any of claims 7 to 11 in which the elongate members and the fastening or clamping means are formed from aluminium.
- 30 13. An universal pick-up device for mounting on a fixture frame to provide an aircraft assembly tool for supporting an aircraft component during the assembly process, the pick-up device comprising a mounting element for mounting the device on the fixture frame, a receiving element for carrying the aircraft component, and a plurality of elongate members having predetermined lengths

connected together by means of clamping elements so as to allow at least three degrees of movement of the receiving element along at least two orthogonal axes and around at least one axis coplanar with the orthogonal axes.

- 5 14. A pick-up device according to claim 13 in which the elongate members are cylindrical and in which the clamping elements are arranged to connect the cylindrical members to one another for six degrees of freedom of movement along and/or about three orthogonal axes.

- 10 15. An aircraft assembly process comprising:
- producing an assembly tool according to the method of any of claims 1 to 6, or providing an assembly tool according to any of claims 7 to 12:
 - mounting at least one aircraft component on the assembly tool, and
 - performing an assembly operation on said at least one aircraft component.

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16. An assembly process according to claim 15 further comprising reconfiguring the assembly tool on completion of the assembly operation, mounting at least one other aircraft component on the reconfigured assembly tool, and performing another assembly operation.

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17. An assembly process according to claim 16 in which reconfiguring the assembly tool comprises adjusting the relative relationship of respective elongate members of the fixture frame, and/or adjusting the locations of respective pick-up devices in relation to the fixture frame.

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